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BITUMEN AND ITS USES*

By A. B. C. LICENCE†

Before entering into a description of the origin, properties, and technical uses of bitumen, it should be mentioned that considerable difficulty has been experienced in attempts to formulate a precise definition of the term "bitumen". This has arisen partly from the wide variation which exists in the sources from which it is obtained and in some of its physical characteristics, and partly from the differences in nomenclature commonly employed according to British and American customs respectively.

For example, some varieties referred to in American technical literature as "asphalts" are spoken of as "bitumens" according to U.K. trade custom, whereas, by British standards, the word "asphalt" is generally used to refer to mixtures of bitumen with inorganic materials such as limestone dust, slate dust, slag dust, and the like. In the U.K. the word "asphalt" is also used to apply to naturally-occurring mixtures of bitumen with earthy and other non-bituminous matter. One of the best known examples of this type is the Trinidad Asphalt obtained from the famous Pitch Lake. The basic bitumen in this case is comparatively soft, but in some natural bitumens found in other parts of the world, for example Cuba and Barbados, it is harder and more brittle. The proportion of mineral matter also varies very considerably, from a fraction of a per cent upwards,

*Lecture given to the London Branch of the Institute, 20 November, 1951

†Berry Wiggins and Co., Ltd.

which in itself gives rise to difficulty in any strictly logical system of nomenclature.

Fortunately, however, despite the incongruities occurring in glossaries and dictionaries, and the somewhat cumbrous attempts by some text book authors to overcome these difficulties, the customary methods of reference employed in industry in either country seldom give rise to misunderstanding.

This is achieved in some cases by the use of qualifying adjectives or abridged specifications. Thus, for example, the bitumen obtained from crude petroleum by distilling off the volatile components is frequently spoken of as "penetration bitumen", since it can be readily specified numerically by quoting its penetration number—a reliable measure of its hardness at a given temperature. A special penetration test is, in fact, adopted by British Customs Authorities as a means of ascertaining precisely the stage in the distillation of a crude petroleum at which the product ceases to be an oil, subject to one scale of duty, and becomes a bitumen, subject to different excise treatment.

When it is desired to emphasize the distinction between such bitumen, and other classes of bitumen derived from it by further manufacturing treatment, it can be referred to as "straight bitumen". If a straight bitumen has been produced by a distillation process under regulated pressure in an atmosphere of steam, it can be referred to as "steam-distilled bitumen", as distinct from that produced when distillation is assisted by partial vacuum, in which case the term "vacuum distilled bitumen" becomes applicable. Such qualifying terms, however, are usually employed only when particular distinction of type is required. When a stream of air is blown through hot bitumen under suitably controlled conditions, the bitumen undergoes certain fundamental changes in composition and properties. The product, which is of growing importance in the arts, is known as "blown bitumen". It has also been referred to as "oxidized bitumen", but there is a tendency for this term to be regarded as obsolete.

In other cases, especially of bitumens occurring naturally formed, difficulties of nomenclature are most frequently avoided by the use of proper names, in which cases the use of the word "bitumen" is usually omitted altogether. Well-known types of natural bitumen treated in this way are, for example: gilsonite, rafaelite, manjak, wurtzilite, and grahamite.

By such simple means, involving in effect the concept that the word "bitumen" is now more a convenient general term of reference than the name of even an approximately consistent identity, it is possible for those interested in the manufacture, sale, and use of bitumen to avoid misunderstanding.

By way of contrast, the official British Standard definition of "bitumen" reads as follows: "Mixtures of hydrocarbons of natural or pyrogenous origin or combinations of both (frequently accompanied by their non-metallic derivatives) which can be gaseous, liquid, semi-solid, or solid and which are completely soluble in carbon disulphide". The suggestion that bitumen may be gaseous and that it may be completely soluble in carbon disulphide will be noted, but such possibilities are not envisaged by those ordinarily interested in the subject. It is true that the above definition is coupled with a qualification in the form of a definition of the compound term "asphaltic bitumen", which reads as follows: "Natural or naturally occurring bitumen, or bitumen prepared from natural hydrocarbons or from derivatives of natural hydrocarbons by distillation or oxidation or cracking; solid or viscous, containing a low percentage of volatile products; possessing characteristic agglomerating properties, and substantially soluble in carbon disul-

phide". From the last proviso it would appear that bitumen may contain some matter insoluble in carbon disulphide if it happens to be asphaltic.

Whilst the foregoing gives a brief indication of the nomenclature at present in use, there is now good reason to hope that, in the near future, the present official definitions may become obsolete and be replaced by others more consistent with the customary terminology of the industry. The Nomenclature Sub-Committee of the IP has already issued a booklet forming the first part of a new *Glossary*, in which suitable new definitions are set forth.

Standard Tests

The manner in which bitumen in its various forms can be standardized will now be considered, starting with the most widely used form—straight or straight-run bitumen. It will be easier to understand the essential properties of this class of bitumen if it is regarded as a fluid—of extremely high viscosity. As in the case of all petroleum oils, its viscosity decreases with increasing temperature according to well-known logarithmic relationships. There is no abrupt change from the apparently solid state to the liquid state on heating. Nor is there any manifest absorption of latent heat. Consequently, if it is wished to specify such a bitumen, it is only necessary to ascertain its viscosity at two temperatures sufficiently wide apart. No ordinary flow type viscometers are suitable for such extremely viscous material, but two other types of test have been successfully standardized for this purpose. They are both essentially arbitrary, but nevertheless adequate and convenient. One of these is the "penetration" test, in which a needle of standard dimensions, loaded with a standard weight, is allowed to penetrate the bitumen under test at a standard temperature, and the depth of penetration in a standard time is recorded as the "penetration" number of the specimen under test. The other is the "softening point" test, in which a steel ball is supported on a disk of the bitumen under test. The assembly is heated and the temperature at which the ball falls through the disk is recorded as the softening point. In this test, the diameter and weight of the steel ball, the dimensions of the bitumen disk, the rate of rise of temperature, and the distance traversed by the steel ball are all standardized.

It is important to notice that in both of these seemingly different tests, the same set of three conditions essential to a viscosity determination is the basis of test control, namely, force (in all cases supplied by gravity), temperature, and rate of motion. In the penetration test rate of motion is the variable, whilst in the softening point test the variable is temperature. For routine requirements, the fixed quantities in both tests have so been chosen that the temperatures at which the viscosities are respectively determined are seldom less than about twelve Fahrenheit degrees apart.

Thus the temperature at which the penetration test is normally carried out is 77°F, at which temperature the softest bitumens give readings in the neighbourhood of 350 to 400. Such bitumens usually have softening points of about 86 – 89°F. Any bitumens still softer can best be standardized by direct determination of their viscosities in large jet flow viscometers by a suitable choice of temperature. At this point, it is important to observe that increase of softening point is associated with decrease of penetration number.

This viscous fluid called bitumen—or asphaltic bitumen—has other important properties rendering it suitable for use in various industries.

It is highly adhesive; generally its adhesiveness increases as its softening point decreases.

It is insoluble in water, and, within limits, water-repellent.

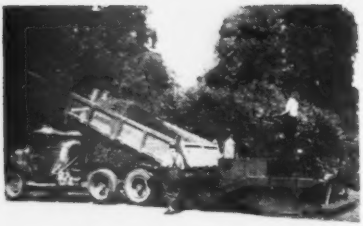

Fig. 1. Barber-Greene finishing machine for road surfacing.

It is a lubricant, under conditions where the relative motion of contiguous surfaces is comparatively slow.

Surface Dressings

These properties render it eminently suitable for use as a binder or cement in the manufacture of bituminous macadam for road surfacing work. Crushed stone is graded over mechanically driven screens, heated and dried, and mixed while hot in carefully adjusted proportions with the bitumen. This preheated bitumen may be simple straight bitumen, or straight bitumen to which has been added volatile or partially volatile liquid flux. Such a mixture is called a "cutback" or cutback bitumen. The fluxes employed may be creosote obtained from coal tar or the kerosine type distillate obtained as a by-product in the distillation process in which the bitumen itself was produced.

Most frequently, the flux consists of both creosote and kerosine. The main object of the flux is to reduce the viscosity of the bitumen temporarily to facilitate handling, spreading, shaping, and consolidation of the mixed stone macadam. During the period when, first by the roller used for shaping the newly-laid material, and later by the momentary downward pressure of passing traffic, its properties as a lubricant assist in increasing the close contact area between each stone chipping and its neighbours, and thus produce a denser and more compacted aggregate than could ever be produced with dry uncoated stone. In the course of the subsequent life of the road surface so constructed there will naturally be periods each year when, under direct sunshine, the road surface temperature is substantially higher than the softening point of the bitumen now functioning mainly as a cement. Yet no disturbance takes place under traffic because of the lubrication effect on the close fitting association of the component stone chippings.

In cases where relatively small areas of road surface are thus to be constructed, the mixed stone is spread by hand, but with large areas it is becoming increasingly the practice to resort to mechanical methods of spreading. In Fig. 1 is shown one of the most successful appliances designed for this purpose. Such a machine will deal with heavy tonnages in a short time, and its successful employment requires close liaison and a high degree of experience and judgment to keep the machine adequately fed with lorry loads of bituminous macadam at the optimum temperature for spreading.

An older form of re-surfacing roads is that known as a surface dressing. In the U.K., the bitumen is almost universally employed in the form of a cutback, and is heated to a temperature at which it can be readily sprayed on to the old road surface at a controlled rate—usually of about one gallon to every 6 to 8 sq. yards. The sprayed surface is immediately served with a scattering of dry stone chippings at such a rate that these lie shoulder to shoulder forming a coat one chipping thick, the maximum size of the chippings being approximately $\frac{3}{4}$ inches. By the precoated bituminous macadam method, on the other hand, carpets of thickness up to 3 inches can be laid.

The process of surface dressing described naturally involves the employment on site of suitable vessels for heating the cutback or maintaining its

temperature where it is delivered hot in bulk.

Another method, not involving the use of heat on site, is available and is indeed a very extensively used alternative. Straight bitumen can be emulsified, if it is heated to a suitable temperature, and passed through a high-speed mill together with a stream of warm water containing small proportions of various substances generally of a soapy nature. This is a factory operation; the emulsion can be stored in bulk, and delivered in drums or tankers for use as required without further heating.

When such an emulsion is sprayed at a suitable rate on to an old road surface, evaporation of its water component rapidly causes the non-volatile bitumen component to separate and assume its normal properties of adhesiveness, and chippings can be applied as with hot cutback surface dressing methods. This method finds especial utility in the treatment not only of roads in areas where the hot cutback method is less convenient, but also in surface dressing pathways and drives in parks and gardens, parade grounds, aerodromes, railway platforms, and suchlike.

For all such work, the proportion of bitumen in the emulsion ranges from about 50 to 60 per cent; but recently emulsions containing 30 to 40 per cent have found considerable use in forming a dust-free bituminous surface on the beds of roads about to receive a carpet of pre-mixed bituminous macadam as previously described. Emulsions so designed and used are usually referred to as "tack-coat" emulsions.

There are other methods of road surface construction, some of general, others of particular, applicability, in which these same properties of bitumen play an essential part, but they are characterized mainly by variation in technique and involve no further essential properties of the bitumen employed.

Bituminous Emulsions

Straight run bitumen is also used in the manufacture of two other types of bitumen-water emulsion.

In the preparation of emulsifying agents, it has been found that by the substitution of casein—a milk product—for fatty acids, in conjunction with the inclusion of small proportions of sodium borate, emulsions of increased stability can be produced. These can remain longer as emulsions under physical conditions conducive to bitumen separation. A number of such emulsions have been in use for many years, mainly with the object of stabilizing soils by mechanical admixture with the emulsion. Much difficulty has been experienced in this branch, owing not only to the great variety of soil compositions to be dealt with, but also because of the essentially wet nature of our climate. Considerable satisfactory progress has, nevertheless, been achieved, particularly with soils of an essentially sandy character. At the present time, a different technique with the same ultimate object is being developed, in which such emulsions are injected into, for instance, the sandy beds and banks of canals.

Yet another distinct type of straight bitumen—water emulsion—has been developed, and has already been instrumental in solving long-standing needs of engineers dealing with problems arising in the waterproofing of thermal insulation and, particularly, refrigeration installations. In the United States, especially in the state of Wyoming, and also in some parts of North Africa, there exist extensive deposits of a clay so finely divided in texture that, on exposure to watery conditions, chemical dissociation takes place and the clay-water mixture forms a sort of jelly dispersed in an alkaline medium. This clay is marketed under the name "Bentonite". The physico-chemical mechanism of this reaction need not be considered here, but the end

effect is that if such clay, gelatinized by admixture with water, is used as the emulsifying agent in the production of bitumen-water emulsions, an entirely different type of emulsion is produced, possessing features of especial interest to the thermal insulation engineer (Fig. 2), and to those concerned in the application of waterproofing coats of bitumen to certain types of building roofs (Fig. 3). In this type of emulsion, the clay/water gel acts as a sort of sponge, with the bitumen in the voids, from which it never escapes, even when the water has evaporated after application. This structure is permanently stable except under exposure to very high temperatures, when carbonization may be expected, or to the action of bitumen solvents. Although pliable, the bituminous coating yielded in this case is not subject to gravity flow, and exposed surfaces are effectively non-adhesive. Emulsions of this class can be readily mixed with inorganic fillers, such as limestone dust, slate dust, sand, and even asbestos fibre, thus affording a wide range of reinforced bituminous coatings suitable for particular purposes and conditions.

Thermal Insulation

For example, high temperature steam pipes have for long been thermally insulated with magnesia-asbestos compositions. At the other end of the scale is the refrigerating engineer, whose problem is to prevent heat from entering his refrigerated chambers. But throughout the temperature range, all are confronted with the necessity of waterproofing the insulating compositions they employ.

Their need has been adequately and completely met by the use of bitumen-water emulsions of the type referred to below.

The steam main engineer still uses his magnesia-asbestos compositions, but protects them externally from moisture by using emulsions of this type. On the other hand the refrigerating engineer uses slabs of cork for his thermal insulating effects, reinforcing or protecting them with a coating of the same type of emulsion (Fig. 4). A further

Fig. 2. Clay-type bitumen emulsion applied to thermal insulation (cork slabs).

branch of the application of such emulsions has also developed within the past few years, namely in the preservation of some fruits, mainly apples and pears, in prolonged bulk storage. In this case the storage chambers are cooled to about 40°F and the emulsion film not only is required to perform as a protective for the cork insulation, but also as a gas seal to contain the gaseous media which preserve the fruit. In this department constant research is still needed and is being energetically carried on.

Putties and Compositions

The use of straight bitumen in the form of "cutbacks" in certain types of road surface construction was mentioned earlier in this paper. By suitable modification of the quality and quantity of the fluxes, and by the incorporation of a sufficient proportion of asbestos fibre, a further range of useful products has been developed. The fluxes may be wholly, or partly, volatile, or they may be effectively non-volatile according to the requirements of the class of work for which they are designed. These products take the form of highly adhesive and waterproof bituminous putties, and find extensive use in the sealing of joints in fabricated roofs, in wood and metal gutters, and rain-water pipes.

Similarly prepared mixtures have been adapted for use in glazing putties, which are being increasingly employed for cementing and luting large panes of glass in factories, railway stations, and similar places where their black colour is of no importance.

In all such cases the asbestos fibre arrests the natural gravity flow of the cutback bitumen.

Straight bitumen is also used in the manufacture of so-called brush-makers' pitch. Originally the bundles of bristles, or "knots" as the brushmaker calls them, were cemented into the holes in the wooden "stocks" by the use of the pitch-residuum from the distillation of pine tar and similar resinous wood products. This method is still to some extent in practice, but such cements are gradually being superseded by blends of straight bitumen with suitable resinous products, which latter afford control of the flow tendency of the bitumen without impairing its high adhesiveness.

Fig. 3. Clay-type bitumen emulsion reinforced with hessian membrane applied to roofs.

As a result of two further important properties which it possesses, straight bitumen has proved extremely suitable for another group of utilities.

Electrical Uses

First of these properties is its extremely high electrical resistance, which in standard electrical units may be taken as about 500 million megohms (that is 500 million million Ω per sq. centimetre over a distance of one centimetre) which for all practical purposes may be taken as infinity.

It also possesses a very high dielectric breakdown strength, or resistance to

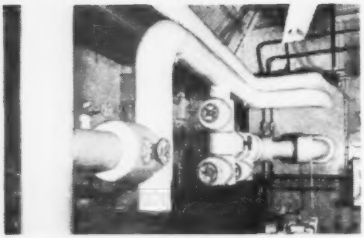

Fig. 4. Cork-insulated refrigeration pipe work protected with sand and asbestos reinforced bitumen emulsion (finished with enamel paint).

mechanical puncture and sparking under the stresses set up by very high electric potential differences. This decreases as the viscosity decreases, and therefore as temperature increases. Dielectric breakdown strength is expressed as the voltage necessary to produce such puncture between electrodes of prescribed dimensions separated by a prescribed distance—usually referred to as the "gap" or "spark gap". Usually, the electrodes specified for standard test purposes are metal spheres of $\frac{1}{2}$ inch diameter.

Some general idea of the dielectric breakdown strength of bitumen as compared with that of dry air is afforded by the fact that, at atmospheric temperatures, a voltage of 50,000 V will discharge a spark between such electrodes over as wide a gap as one inch. If, however, bitumen of 150 F softening point is used as an insulator between these electrodes the gap between them can be reduced to as little as 1/20 inch and still no spark or puncture would be produced by this 50,000 V potential. Wherever joints in electric cables are necessary in underground installations, straight bitumen is a reliable and readily applied protective insulator. But for this purpose it must be sufficiently pure, and free from even minute traces of some types of impurity. For commercial reasons, this high degree of purity is attained rather by selection, blending, and careful process control, than by direct refining methods.

Fig. 5 shows two typical examples of underground electrical Tee joints actually installed by the Electricity Department of the City of Leeds. The bitumen employed in these cannot be seen, of course, as it is completely enveloped by the cast iron shells of the joint boxes. The lead-covered, oiled-paper insulated cables are seen entering the boxes at the plumbed joints.

Inside such a joint box, the cable ends are stripped of their insulation and protective sheathing, and the desired metal-to-metal joints carefully made up. The cover of the box is then securely bolted on, and the hot bitumen compound is poured in through the vent holes provided until the cables and joints are completely submerged. The boxes must not, however, be completely filled with bitumen. Although underground, the temperature of the box naturally varies through the seasons, and in addition heat is generated in the conductors when they are under load, whilst they cool down gradually when the load is reduced. As the coefficient of cubical expansion of bitumen is about twenty times as great as that of cast iron, it is obvious that room must be provided for an appreciable differential expansion—a provision that is invariably taken into account in modern joint box design.

Such uses of bitumen cover an extremely wide and important field in electrical industry. Space will not permit more than a mention of the multitude of different types of heavy duty switchgear, circuit breakers, transformers, feeder pillars and other substation equipment into the design of which its employment plays an essential part, but in Fig. 6 it is used in a somewhat unexpected position. The picture shows a typical 132 kV oil circuit breaker of the three-tank type as utilized on the British grid. The bitumen is here used as a bushing protector and insulator in the upper ends of the flanged porcelain insulators, two of which are seen

protruding from each of the tanks.

In all of these uses, the choice of the right viscosity is of vital importance. At the maximum working temperature of the particular part of the electrical apparatus concerned, the viscosity must not be so low as to entail risk of creepage into the cores of cables, whilst at minimum temperatures it must be low enough to maintain adequate adhesiveness and rate of flow under gravity to ensure an even shrinkage as contraction ensues with falling temperature.

Such variations in duty range from the conditions experienced with, for example, pole transformers at high altitudes in winter, to those obtaining with the fan motor installations in the boiler room annexes of power stations, and in the high temperatures reached in some parts of battleships and submarines.

Before leaving the electrical industries, another group of utilities—the radio equipment branch—to which bitumen is widely applicable must be mentioned. The tops of many types of electric capacity condensers need adequate sealing for protection against the ingress of moisture, dusty impurities, and harmful vapours. Small transformers, choke coils, and suchlike need a complete protecting envelope. For such purposes adhesiveness, resilient flexibility, and freedom from brittleness are still essential, but persistent fluidity is neither required nor permissible. To meet such demands, straight bitumen is no longer available. The requirements of such uses are met by two methods often employed jointly. The first is the use of blown bitumen, which can be manufactured to remain effectively solid and non-flowing over any desired temperature range.

Fig. 5. Bitumen-filled junction boxes for underground cables.

Blown Bitumen

In the second method, recourse is had to the fact that when bitumen is blended with certain waxy materials its flow tendencies are reduced. In simple mixtures this effect is accompanied by an undesirable reduction in adhesiveness, but by the additional incorporation of certain resinous substances, a sufficient degree of adhesiveness can be retained whilst still achieving the desired solidity.

An increasingly large number of complex compositions is constantly being developed by continuous research to meet an ever-increasing range of highly specialized requirements. The waxy and resinous substances thus brought into use include a considerable and increasing variety of materials of synthetic origin.

Brief mention has already been made of the properties and correlated uses of blown bitumen. By the blowing process it is possible so to alter the characteristic viscosity curve of bitumen that considerably higher softening points can be obtained without reduction of the penetration number. This is accompanied—to a degree determined by the extent and conditions of air blowing—by greatly diminished tendency to flow at atmospheric temperatures, and by a reduced degree of adhesiveness.

Blown bitumens are more like rubber, and, in fact, some of the more intensively

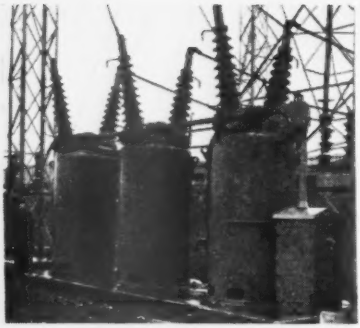

Fig. 6. In this 132 kV circuit breaker bitumen is used to protect and insulate bushings.

blown bitumens are marketed under the name "mineral rubber". They are still adhesive enough to stick firmly to surfaces to which they are applied while sufficiently hot, but cooled off exposed surfaces no longer possess the persistent stickiness characteristic of the straight bitumens.

Blown bitumens can be readily mixed with inorganic fillers, such as limestone and slate dusts, etc., and with asbestos fibre, thus enabling their mechanical and physical properties to be modified to meet a wide range of uses. They are used to a considerable extent as an exterior protection, and an interior lining of large water main pipes. The bitumen is applied while hot and freely liquid, and in the latter case the pipe may be rapidly spun whilst cooling off. By this means a very highly polished surface is produced, which plays an important part in reducing the skin friction of water passing through the pipes, thus economizing the power required for pumping over long distances.

Blown bitumen is also very widely used as the waterproof coating of roofing felts, and the impregnated fabric of damp course materials.

It can be emulsified by any of the processes already described in connection with straight bitumen, but there is much room for further development in this field.

Natural Bitumens

Having now dealt with the two principal forms of bitumen primarily derived from crude petroleum oil by artificial distillation, it remains to make reference to the naturally occurring bitumens. As examples are taken what are believed to be in the U.K. the two best known and widely used types, namely gilsonite and rafaelite. These are much alike, rafaelite usually possessing the higher softening point, 350–400°F, that of gilsonite being about 270–330°F. They are both so hard that they give no appreciable penetration number under ordinary conditions of test. Both are extremely brittle, even at temperatures considerably above the atmospheric range, and, in their natural state, are quite devoid of adhesiveness. But with careful temperature manipulation, they can be blended with straight bitumens, blown bitumens, mineral oils, and some vegetable oils, producing more easily handled products of an intermediate character. By their use in this way, a range of high softening point blends is available which is beyond economic reach with both blown and straight bitumens. Bitumens of this class are mainly used in the manufacture of bituminous paints, lacquers, japans and enamels, fine printing inks, floor tiles, and in thermo-plastic moulding compounds.

In this review, no claim is made to have mentioned all the present uses of bitumen. It was felt more desirable to emphasize in particular those properties available in the variety of forms mentioned, which are the basic reasons for their employment in the various arts referred to. For the benefit of those sufficiently interested to desire a more comprehensive inventory of bitumen uses, reference is recommended to the catalogue published in the

Journal of the Institute* in the interesting and informative paper by A. W. Jarman on "Bitumen Horizons".

J. Inst. Petrol, 1950, **36**, 2-13.

The author has pleasure in acknowledging the very considerable assistance and helpful criticism received from Messrs R. P. Bell and K. A. Wheeldon during the preparation of this paper.

★ ★ ★

VAPOUR PRESSURE OF LIQUEFIED GAS

A Warning

Several laboratories in Great Britain are now using the N.G.A.A. "Inverted Reid" procedure for determining the vapour pressure of liquefied gases and this procedure is in fact under consideration by the Petroleum Gases Panel of Sub-Committee No. 3 as a possible IP Standard. The method involves the use of a bomb conforming to the general overall dimensions of the Reid bomb, but differs from the normal vapour pressure procedure in that the large chamber (i.e. the normal 'air compartment') is filled with the liquid sample, while the small chamber is used to provide ullage space, but contains only sample vapour and not air. For determining the vapour pressure of *butane* samples (at temperatures up to 45°C) it is normally safe to use a standard Reid bomb, but the Petroleum Gases Panel wishes to emphasize the dangers which can occur when using such a bomb for propane or propylene samples.

1. For conformity with IP 69/45, it is only required that a Reid bomb be tested to 100 psig, and certain bombs therefore may not be safe for use with samples whose vapour pressures are of the order of 200-300 psi. It is therefore essential that a suitable pressure test be carried out before a Reid bomb is used for C_3 samples.

2. The above warning is obvious and probably unnecessary. A further source of risk however is less obvious. Thus, it may not be realized that in the Reid bomb with a volume ratio of 4 to 1 between the two chambers, the expansion of the liquid already filling the large chamber, could, under certain circumstances be so great as to exceed the available free volume of the small compartment, with consequent risk of bursting the bomb due to hydrostatic pressure. This applies particularly to propylene samples, if they are cooled, on charging, to a temperature near the boiling point of propylene and then warmed in the bomb, to the normal test temperature of 45°C (113°F). Users of this method are therefore strongly warned to avoid excessive cooling of such samples when charging the vapour pressure bomb.

The Petroleum Gases Panel is considering the design of a modified bomb, of light weight, in which the volume ratio between the two compartments will be such as to eliminate this danger.

J. H. D. Hooper
Chairman—Petroleum Gases Panel.

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DRILLING ON I.O.W.

Following gravity and seismic reflection surveys, an exploratory well is to be drilled by the D'Arcy Exploration Company on the Isle of Wight. The location is almost exactly in the middle of the island, about one-half mile south-west of the village of Arreton, and will thus be remote from holiday centres. Work is scheduled to begin as soon as AIOC's well at Ainsdale-on-Sea, Lancs, is completed.

PERSONAL NOTES

H. D. Demoulins, M.Inst.Pet., a member of the Esso Petroleum Co.'s board of directors, recently retired at his own request. Mr Demoulins, who had been in the service of the Esso group for more than 31 years, was since 1948 a member of the new Esso Refinery Planning Group and was concerned with the co-ordination and planning in the United States of the Fawley refinery.

Camille Le Clair, M.Inst.Pet., has recently taken up residence in Canada at 25 St. Andrews Gardens, Toronto, and is now in practice as a consulting engineer.

C. H. E. Rebbeck has been appointed resident engineer for the construction of AIOC's new 3,000,000 tons p.a. refinery which is to be built at Kwinana, near Fremantle, Western Australia. For 3½ years, he has been superintendent of the expansion scheme at Grangemouth refinery.

N. B. Fuller, since 1945 general manager of Western Markets division of AIOC'S distribution department, retired recently. Mr Fuller's career with the group began shortly after the first world war and he served for many years with the company's affiliates on the European continent.

Paul F. Swanson has been appointed manager of the process engineering department of M. W. Kellogg Co. He joined the company 25 years ago, after taking his chemical engineering degree at the University of Kansas.

We regret to record the death at the age of 48 of **Roland Scott,** M.Inst.Pet., chief chemical engineer to the Midland Tar Distillers Ltd. Mr Scott spent the early years of his career with I.C.I. at Billingham, later went to Foster Wheeler Ltd., joining Midland Tar Distillers in 1938.

Arnold Watson, O.B.E., general sales manager of C. C. Wakefield & Co. Ltd., during the last four years, has been elected to the board. He joined the firm in 1929 and during the last war served as chief test pilot, Air Transport Auxiliary.

Niels Matheson, F.Inst.Pet., has resigned his directorship of British Oilfield Equipment Co. Ltd. in order to devote more time to his appointment as director of Associated Tube Wells Ltd.

It is with regret that we record the death of **Leonard D. Derry,** A.F.Inst.Pet., which occurred on June 6 during a business visit to the U.S.A. He was in charge of diesel fuel, burner fuel, and lubricants research at Abingdon laboratories of Esso Development Co.

HER MAJESTY'S BIRTHDAY HONOURS

Congratulations to **George Noble,** J.P., Chairman of the Fawley Branch of the Institute and manager of the Fawley refinery, Esso Petroleum Co., and to **Kenneth Brebner Ross,** F.Inst.Pet., late general refineries manager, Anglo-Iranian Oil Co. Ltd., Persia, both of

whom have been appointed to the O.B.E. on the occasion of the Celebration of the Birthday of Her Majesty the Queen.

Also included in the lists of Birthday Honours are :

Knight Bachelor

Henry James Ross, director of Tankers Ltd.

C.B.E.

Harold Ernest Snow, O.B.E., deputy director, Anglo-Iranian Oil Co. Ltd.

O.B.E.

Richard Ernest Hadley, chief engineer officer, s.t.s. *Velutina*, Anglo-Saxon Petroleum Co. Ltd.

Alan Anderson Pratt, chairman, Southern Oil Co. Ltd.

Michael Willcocks, manager Anglo-Egyptian Oilfields Ltd. refinery, Suez.

M.B.E.

John Henry Freeman, J.P., lately manager Coryton oil installation, Vacuum Oil Co. Ltd.

Aubrey Rockett Wakeham, technical officer, Petroleum Division, Ministry of Fuel and Power.

B.E.M.

David Mill Galloway, donkeyman, m.v. *Regent Lion*, C. T. Bowring & Co. Ltd.

George William Lloyd, carpenter, m.v. *Auricula*, Anglo-Saxon Petroleum Co. Ltd.

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COUNCIL COMMENTARY

At the 14 May meeting of Council the new President, Mr H. S. Gibson, C.B.E., occupied the chair for the first time and welcomed Messrs A. J. Goodfellow, E. C. Masterson, A. R. Stark, and W. H. Thomas as new members of Council. He also expressed the appreciation of Council of the work done by Mr M. A. L. Banks during his term of office.

Mr Hyams is visiting the U.S.A. to attend a meeting of the International Standards Organization and while there he will represent the Institute at an ASTM meeting to be held in New York in June. He will convey in person to the ASTM the Institute's sympathy at the death of Mr C. L. Warwick, their executive secretary.

It has now been agreed to sign the new lease for Manson House. Any additional increase in rates due to the new rating scheme will probably have to be met by the IP but this contingency may not arise for some years yet.

Arrangements for the Summer Meeting were discussed. Mr Gibson and Lord Waleran accepted invitations to give talks during the week-end and a third speaker was being considered. Applications for tickets which at first came in very quickly had slackened and it was therefore agreed that the meeting should be thrown open to friends of members of the Institute.

There was much discussion on IP representation on BSI committees. The BSI asks the Institute when it requires representatives of the oil industry on its committees and these representatives are shown as representing the Institute of Petroleum. This was objected to by some Members of Council who preferred that they should be shown as petroleum company representatives and suggested that the IP should have one representative only on each BSI committee. Various points of view were put forward and eventually a motion was carried that "Council confirms the present arrangements by which the Institute nominates representatives of the petroleum industry on BSI committees".

In order to operate the Covenant scheme it is necessary to alter Article of Association No. 8 and By-laws Nos. 41 and 72. A Special General Meeting to agree this was called for June 11.

U.K. PETROLEUM CONSUMPTION

Statistics issued on behalf of the U.K. Petroleum Industry Advisory Committee by the Petroleum Information Bureau show that in 1951 total consumption in the U.K. of all petroleum products amounted to 16,887,908 tons, an increase of 10.5 per cent over the 1950 figure.

Details given in Table I show that all products shared in the increase. Of the total 1951 consumption it is of interest to note 85 per cent was accounted for by motor spirit (32.3 per cent), gas, diesel, and fuel oils (35.5 per cent), kerosine (10.5 per cent) and derv fuel (6.7 per cent). From the details given in the full statistics it is noted that the use of oil fuels in the steel industry rose from 884,557 tons in 1950 to 968,990 in 1951, while the gas industry consumed 556,660 tons in 1951 against 539,611 in 1950.

TABLE I

PETROL CONSUMPTION IN THE U.K.

	1950	1951
	Tons	
Aviation spirit	281,989	334,148
Motor spirit*	5,195,173	5,454,264
Industrial spirits†	80,667	98,340
White spirits	148,994	149,604
Kerosine‡	1,539,024	1,775,929
Derv Fuel	1,034,103	1,125,623
Gas, diesel, and fuel oils:		
Burning	2,882,140	3,237,459
Power	1,018,466	1,170,981
Gas manufacture	539,611	556,660
Refinery consumption	649,775	871,416
Petroleum industry	118,057	121,667
Other uses	129,742	42,830
Lubricants	748,796	797,172
Paraffin wax and scale	43,177	49,750
Butane and propane	30,251	37,544
Bitumen	621,281	745,647
Miscellaneous	215,525	318,874
	15,276,771	16,887,908

*Including motor benzole.

†Including industrial benzole.

‡Including aviation turbine fuel, burning oil, and vaporizing oil.

In 1951, as shown in Table II, the production in U.K. refineries of products from imported and indigenous crude and process oils, including shale oil, was 77 per cent higher than in the preceding year. In comparison, the output of motor and aviation spirit and of fuel oil was nearly doubled and the latter represented nearly half of the total refinery output.

TABLE II

U.K. REFINERY OUTPUT

	1950	1951
	Tons	
Motor and aviation spirit	1,477,955	2,923,181
Industrial spirit	3,401	3,239
White spirit	48,826	51,641
Burning oil	147,619	226,594
Vaporizing oil	12,877	18,507
Gas and diesel oil	1,890,745	3,055,076
Fuel oil	4,344,740	8,502,845
Bitumen	636,085	746,227
Paraffin wax, etc.	15,563	15,117
Lubricating oil	427,288	412,154
Propane and butane	23,736	19,337
Miscellaneous and loss	254,917	456,107
	9,283,752	16,430,025

In addition to petroleum products certain indigenous fuels are made available for distribution by the petroleum industry. Thus, in 1951 refined benzole totalled 78,996 tons (188,842 in 1950), motor and aviation spirit by hydrogenation 111,862 tons (130,177 in 1950), and motor spirit by low-temperature carbonization nil (949 tons in 1950).

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WORLD OIL CONDITIONS

In the Annual Report for 1951 of The "Shell" Transport and Trading Co. Ltd., Sir Frederick Godber, F.Inst.Pet., chairman, refers to the problems arising from the loss of Persian supplies. By the concerted action of the British and American Industry Committees, considerable progress has been made towards development of alternative supplies, in particular of crude, but there will remain for some time a shortage of refinery capacity outside the U.S.A. and the consequent necessity to purchase products—mainly aviation gasoline, kerosine, and gas diesel oils—from that country.

The determination of the industry to overcome these supply difficulties was a significant symptom of world reactions to events in Persia. The funda-

mental issues at stake were immediately recognized by all. Failure by Governments to respect solemn obligations must reflect disastrously on those who practise it.

World consumption totalled 4250 million barrels in 1951, an increase of 10 per cent over 1950, and a reflection of the expanding importance of oil as a source of energy. In 1951, oil and natural gas provided over one-third of total energy needs. A significant feature outside the U.S.A. is the high demand for fuel oil. In the Eastern Hemisphere fuel oil represented 38 per cent of total demand for all oil products in 1951 compared with 26 per cent in 1938 and 33 per cent in 1947.

In an interesting brochure accompanying the report and dealing with the 1951 activities of the Shell and Royal Dutch Group, world production figures are given as:

	1951	1950
	Million Barrels	
U.S.A.	2450.0	2155.5
Venezuela	623.4	547.1
U.S.S.R. and Eastern Europe	341.4	308.5
Saudi Arabia	278.0	199.5
Kuwait	204.9	125.7
Persia	125.0	241.4
Mexico	79.6	74.6
Iraq	64.6	49.8
Indonesia	56.1	47.9
Canada	48.1	29.1
Colombia	39.1	34.8
British Borneo	37.5	31.0
Argentina	25.1	23.5
Trinidad	21.0	20.9
Qatar	18.3	12.3
Peru	17.2	16.1
Egypt	16.4	16.4
Austria	14.7	11.3
Bahrein	11.0	11.0
Western Germany	9.7	8.0
Netherlands	5.0	4.9
Ecuador	2.9	2.8
France	2.4	1.1
Japan	2.3	2.1
India	2.0	2.0
New Guinea	1.8	1.8
Others	8.2	5.6
TOTAL	4505.7	3984.6

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Bahia Expansion. Improvements that will double the capacity of the present 2,500 b.d. combination thermal refinery at Mataripe, Brazil, are to be carried out by Kelloggs for Conselho Nacional do Petroleo.

IRAQ PRODUCTION

Total crude oil production in 1951 by the Iraq Petroleum Company and associated companies was 10,456,413 tons, an average of 28,648 tons daily, the details being:

	tons
Iraq Petroleum Co (Kirkuk)	7,987,024
Basrah Petroleum Co (Zubair)	137,176
Petroleum Development (Qatar) Ltd (Qatar)	2,332,213

For the first quarter of 1952 total production has amounted to over three million tons, the detailed figures being:

	January	*February*	*March*	*Total*
	tons	*tons*	*tons*	*tons*
Kirkuk	670,745	718,161	864,291	2,253,197
Zubair	61,190	114,020	191,645	366,855
Qatar	229,605	238,609	270,594	738,808
	961,540	1,070,790	1,326,530	3,358,860
Daily average	30,107	36,924	42,791	36,911

The steady increase in daily average production is worthy of record and it is to be noted that the new 30-inch pipeline from Kirkuk to Banias did not come into operation until April 9. On that date the first shipment of 15,000 tons left Banias in the *Barren Hill* and arrived at Fawley refinery on April 25.

Figures for April show that the increase in daily average continued, being 47,093 tons for that month, and that for the first time in its 25 years history the Iraq Petroleum Co. produced over a million tons in one month from Kirkuk. Details for the three areas are:

	Tons
Kirkuk	1,013,404
Zubair	154,261
Qatar	255,123
	1,412,788
Daily average	47,093

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COMPANY PRODUCTION—CRUDE OIL

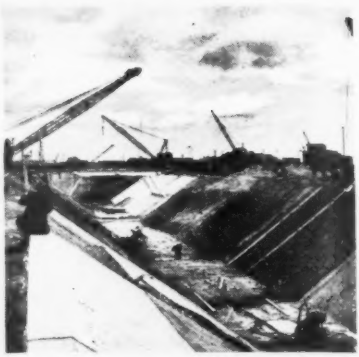
	April 1952
	Tons
Kuwait Oil Co.	3,191,151
	Brl.
Kern Oil Co.	
California	110,202
Trinidad	69,310
Trinidad Petroleum Development Co.	249,656
British Controlled Oilfields Ltd.	
Venezuela	
Western Area	12,401
Central Area	15,881

AIOC KENT OIL REFINERY

Progress on the erection of Anglo-Iranian's new 4 million tons a year refinery on the Isle of Grain is such that, in spite of certain delays due to steel deliveries, the first stage will be in operation by mid-1952.

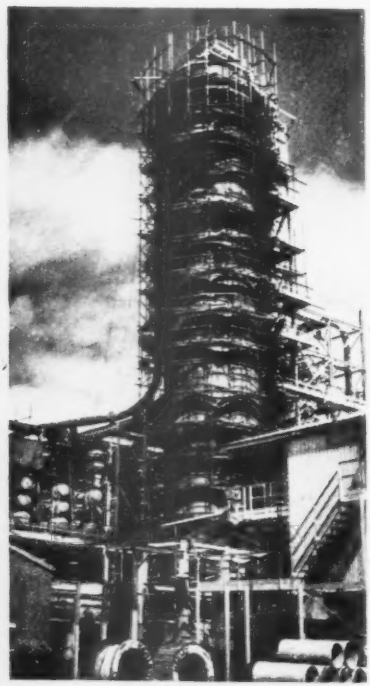
When the refinery is fully completed the annual production of the principal products will be:

	Tons
Motor spirit	965,000
Kerosine	110,000
Tractor vaporizing oil	29,000
Gas oil	490,000
Fuel oils	1,862,000
Lubricants	140,000



The cooling water channel from reservoir to pump house.

Work on the site first commenced in July 1950 and by the time the plant is fully completed the following quantities of materials will have been used in its construction: steel, 112,000 tons: cement, 30,000 tons: bricks, 17,000,000; timber, 600,000 cu.ft; and 750,000 cu. yards of earth will have been moved and 900,000 cu.yards of sand pumped ashore.



The main fractionating column receiving its application of insulation and paint.

Examination of the site of some 2000 acres showed that it consisted mainly of marsh below high tide level. It was found that a layer of alluvial mud, varying from a few feet to as much as 90 feet in thickness, covered a patch gravel bed deposited on the London clay. Drainage ditches were first cleaned out and the area filled to the desired level by deposition of sand. The sand was brought up from the Thames estuary and washed in with sea water which drained away and left a hard sand deposit.

The Three Stages

The refinery will be completed in three stages. Stage 1 comprises an 80,000 barrel per day distillation unit complete with auxiliary sweetening and blending plants. The distillation unit was originally intended for use in the refinery at Haifa, but when its use in that area was precluded by political

developments, it was stored for its present use. As mentioned above, this stage is almost complete.

Stage 2, which is due for completion by mid-1953, incorporates the catalytic cracking plant with its vacuum unit. The cat cracker will have a daily capacity of 10,000 barrels.

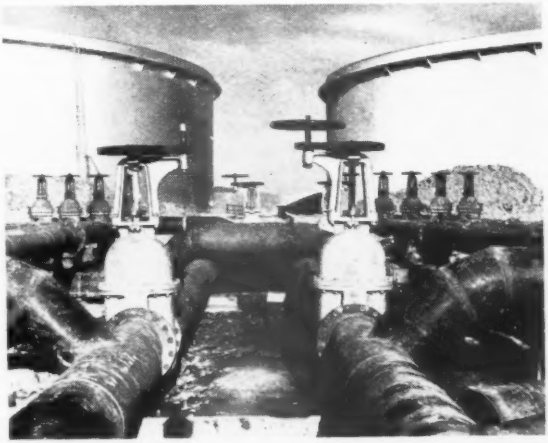
The final Stage 3 will comprise the lubricating oil refinery, with an output of about 140,000 tons per annum. Units will be provided for vacuum distillation, for de-asphaltizing, for solvent extraction, for dewaxing, and for clay filtration. A blending and packaging installation will permit dispatch of about 60 per cent of the products in bulk by road, rail, and sea, the balance being distributed in 44-gallon barrels.

A possible fourth stage of the refinery will be plants for the manufacture of special products.

Cat cracker under construction. The base of the regenerator.

Auxiliaries

For cooling purposes 4 million gallons per hour of Medway water will be required. For this purpose a reservoir has been constructed by means of a new section of sea wall, and from this reservoir a concrete channel will convey the water to the main pump house. Initially the reservoir will be filled by tidal action but as demand increases three electrically-driven pumps will be used to augment the supply.



Crude oil tanks and in the foreground a manifold in the pipeline system.

When completed the refinery will need 430,000 lb/hr process steam and 14,500 kW electricity. For these supplies five 150,000 lb/hr boilers and four 4,000 kW turbo-alternators will be installed.

For incoming supplies of crude oil from the Middle East, there will be four deep-water jetties each capable of berthing the largest tankers now afloat, and an additional jetty for loading lubricating oils in packages. Storage tanks for crude will all be 144 feet in diameter but will vary in height—24 ft, 30 ft, or 60 ft—according to the type of subsoil on which the tank is erected.

As in all refinery operations, stores and maintenance are of considerable importance. The main stores and workshops will have a floor area of 38,250 sq.ft. for workshops and 14,000 sq.ft. for stores—52,250 sq.ft. in all. Chemical stores will be housed in a separate building of 12,800 sq.ft., and the office block will cover 9,400 sq.ft.

Grain's Oil History

The refinery at present under construction on the Isle of Grain is not the first in this area for, in 1923, the Medway Oil and Storage Co. erected a refinery and tank farm in the south-west corner of the island. Nine years later that refinery was dismantled but the storage was continually increased. In 1939 the same company built an underground storage installation at Wallend and in 1944 a branch of the "Pluto" pipeline was connected to this storage.

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KENT REFINERY PERSONALITIES

(Top Left) C. S. Cleverly, O.B.E., A.M.I.Mech.E., A.M.Inst.Pet., general manager. Has been with Anglo-Iranian for twenty-eight years and was chief construction engineer at Abadan, resident chief engineer at Haifa and has also been chief construction Engineer for AIOC's home and overseas refineries.

(Centre Left) A. W. G. Trantor, B.Sc. (Eng.), M.I.Mech.E., works manager. Joined Anglo-Iranian in 1935 after apprenticeship with a Scottish engineering firm and has worked principally at Abadan where he was chief engineer.

(Bottom Left) J. H. Evans, general manager of Medway Oil and Storage Co.'s installation, with which firm he has been associated for twenty-eight years ; has worked in laboratory and refinery processes as well as on oil accountancy, shipping, storage and installation.

(Top Right) D. S. D. Fraser, project manager. Joined Anglo-Iranian sixteen years ago, previously having held civil engineering posts in India for ten years. Has held senior construction engineering posts at Abadan, Haifa, Kuwait and Llandarcy refineries.

(Centre Right) L. R. Gascoine, deputy project manager. Has been with Anglo-Iranian for twenty-five years including fourteen years in Persia on design, maintenance and development, has spent two years in the U.S.A. on aviation spirit processes and five years in head office. (Bottom Right) N. W. Grey, F.Inst.Pet., M.I.Chem.E., project engineer. Has been twenty-seven years in the petroleum industry, seven with Anglo-Iranian and fourteen in Peru on refinery construction engineering, and for four years was engineering supervisor for the Celanese Corporation of America.

PETROLEUM IN PARLIAMENT

U.S. Oil Strike

In a written reply on 15 May the Parliamentary Secretary to the Ministry of Fuel and Power said: As a result of the strike in the United States refineries, the U.S. Government has suspended all exports of aviation spirit. Since the rest of the world has been drawing a large part of its supplies from the U.S.A. this is obviously a very serious matter and Her Majesty's Government has accordingly had to restrict consumption of aviation spirit in this country, and in conjunction with the U.S. Government has advised other countries to do the same.

Equipment Contracts

The Minister of Fuel and Power was asked on 19 May what considerations prevented or deterred British manufacturers of equipment for oil refineries and installations from tendering for recent large-scale projects in the U.K. and elsewhere in the Commonwealth and Empire; and what administrative steps he was considering in order to encourage British firms to tender.

In a written reply Mr Geoffrey Lloyd said that the oil companies found it necessary to employ as main contractors firms which have had the greatest experience on these large-scale projects. The maximum amount of civil engineering work as opposed to the erection of technical plant was, of course, always carried out by British contractors.

His Department had for some time been giving every encouragement to the manufacture of petroleum equipment in the U.K. but the question of tendering was a matter between the oil companies and the manufacturers.

High Octane Fuel Supplies

In a written reply on 26 May, the Minister of Fuel and Power said that the requirements of the R.A.F., the R.N., and British air lines for high-octane fuel are supplied by the British and American companies who distribute this fuel. Only small quantities are currently made in the U.K. and the companies draw the bulk of their supplies from their refineries in the East and West Indies, and partly from the U.S.A. With the completion of the U.K. refinery expansion programme the quantity of aviation spirit made in the U.K. will be substantially increased, but part of its supplies will still be imported.

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AIOC AUSTRALIAN REFINERY

Following the Western Australian Parliamentary ratification of the agreement between the State Government and the AIOC, further details were announced of the plan to build a new refinery at Kwinana, on Cockburn sound. The site chosen lies about 12 miles south of Fremantle, one of Australia's main bunkering ports, and is favourably placed geographically for tankers coming from the Middle East, which will be the source of the supply of crude. The refinery area is about 900 acres of level bare scrub, well above sea level, with good load-bearing properties and alongside sheltered deep water where 28,000- and 32,000-ton tankers will be able to discharge crude.

The Western Australian Government have undertaken to make the land available, supply fresh water and electricity, build some 1000 houses for future employees, lay roads and railways to the site and carry out the necessary dredging of the water channels.

The plant will consist of atmospheric and vacuum distillation units with the usual accompanying treatment plants.

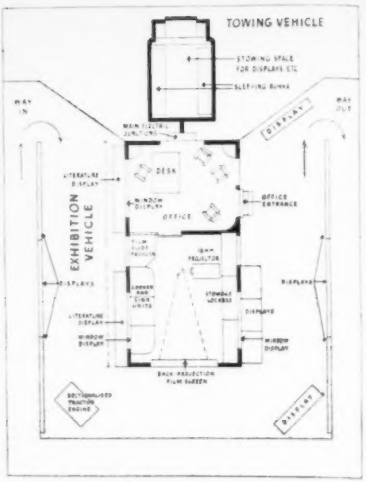
The exhibition vehicle, on the back of which is the cinema screen, the front portion with steps in position being the office compartment.

AGRICULTURAL MOBILE EXHIBITION

An interesting mobile exhibition designed to bring to the attention of the farmer what the petroleum industry is doing for agriculture, and to demonstrate how tractors and other farm machinery can give their best performance, was recently shown to a gathering of press representatives.

Sponsors are Manchester Oil Refinery (Sales) Ltd., and the exhibition, which is entirely mobile, is wholly contained in a towing vehicle and a 21-foot caravan type trailer. The towing vehicle also contains two sleeping bunks for the attendants.

When in position the caravan forms the centre piece of the exhibition and attached awnings provide a roofed area of 1000 sq.ft., the whole exhibition covering a site of nearly 5000 sq.ft.



General layout of the exhibition when erected.

In the covered space are located various displays showing the development of mechanization in agriculture, a Perkins P.4. diesel cut away to show working parts, a demonstration of the effect of lubricating oil contamination, and a cinematograph with a continuous projector which can show a programme of up to three hours duration.

This mobile exhibition will be seen at the principal British agricultural shows this year.

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TO SEA WITH SHELL

For young men who are considering making the sea their career, a well-illustrated brochure titled *Shell Tanker Fleet Service* gives a broad outline of the life and prospects for the young man who joins that fleet as an apprentice. Enclosed with the brochure are pamphlets setting out the pay rates for tanker personnel, from master downwards.

"INSTRUMENT ENGINEER"

First published by George Kent Ltd. in April 1952 this new Journal, which will appear twice yearly, is intended for the engineer whose concern is mainly or wholly instruments. The first number contains three articles in this category and a fourth contribution is an historical account of the work of Venturi. Price 2/6d per copy, annual subscription 5/-.

"PETROLEUM MEASUREMENT MANUAL"

Everyone in the petroleum industry who is concerned with petroleum measurement and calculation of bulk oil quantities realizes that accuracy in oil measurement involves not only skill, but also the use of standardized procedure and carefully calibrated equipment. Oil measurement processes do not lend themselves to exactness, but practical accuracy is always essential in the sale, purchase, and handling of petroleum. By this means possible disputes between buyer and seller are obviated and adequate control over loss in storage and distribution is provided by accurate measurement.

From time to time, oil companies and others have issued instructions on the equipment and procedure to be used by their staffs in measuring and calculating oil quantities. In the U.S., petroleum organizations have published recommendations on specific aspects of the problem and occasional articles on the subject have appeared in the technical press. But it was not until the ASTM published their manual on measurement and sampling a couple of years ago that any authoritative and comprehensive set of instructions had been available covering all steps involved in these measurements and calculations.

The Institute of Petroleum, which for the last twenty years has had one of its standardization committees devoted solely to the subject of measurement and sampling, has now published a volume entitled "Petroleum Measurement Manual". This is the third of that committee's publications, the previous being "Standard Weights and Measures" and "Tables for Measurement of Oil".

"The Petroleum Measurement Manual" comprises six parts, covering tank calibration, oil gauging, sampling, temperature measurement, specific gravity, and calculation of oil quantities.

The text of the volume has been so written that the methods and apparatus specified can be used with equal facility in metric countries and it is certain that the adoption of the recommended procedures will enable the closest possible correlation to be achieved between calculated quantities involved in national and international petroleum transactions.

"The Petroleum Measurement Manual", containing 227 pages with all necessary illustrations of apparatus and equipment, can be obtained from the Institute, price 25/- post free (members of the Institute may obtain one copy at 22/6d).

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ENGLISH FOR FINNS

Taking a car to Finland for the Olympic Games might on the face of it appear a chancy proposition, but the Shell people over there have in mind the comfort of the English-speaking motorist. They have published a booklet *Huoltomiehen Englantia* (Maintenance Men's English), which takes the Finnish garage attendant step by step through his encounter with the visitor, standard phrases being given first in Finnish, then in English (phonetic) and finally in written English. Thus, the attendant is equipped to deal with such alarming requests as "Rimmuuv mai broukknn glass" and perhaps to reply firmly "Juu massnnt paak hie!"

The booklet is embellished with gay line drawings.

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"Laboratory Practice".—This is a new monthly which first appeared in April 1952 and which is "concerned entirely with practical aspects of scientific work". Price is 4s. per issue (£2 5 0 per year) and publishers are United Trade Press, Ltd., 24 Bride Lane, London, E.C.4.

AROUND THE BRANCHES

Fawley Branch

An address entitled "Chemicals from petroleum" illustrated by slides and a film was given by Dr A. Winward, at the Esso Recreation Club, Holbury, on 16 April, I. McCallum being in the Chair.

Dr Winward opened his talk by describing the extensive development which had taken place in recent years in the manufacture of chemicals from petroleum. There was at present a very wide interest in this field of development to some extent due to the widespread expansion in petroleum refinery capacity both in the U.K. and in Europe.

The lecturer quoted figures showing the large expansion in capital investment in this new industry both in the U.K. and in the U.S. He pointed out that this rapid growth had been made possible by improved distillation techniques; ready availability of suitable raw materials from recently developed manufacturing operations in the petroleum field; development of new direct oxidation processes; the growth and demand for organic chemicals, particularly of the aliphatic type.

In addition to the demand for organic chemicals which have an established place in industry, there is continual development taking place in such specialized products as V.I. improvers, additives, inhibitors, etc.

During the last five years five steam cracking units have been constructed in the U.K. for the production of raw materials for chemical manufacture. Some of these plants have been erected by petroleum organizations, others by associated industries.

Dr Winward discussed the manufacture of synthetic rubber and showed that a large part of the U.K. requirements in this field could be supplied by using raw materials from U.K. refineries.

The speaker concluded by expressing the opinion that there is still likely to be a very considerable development in the petrochemical field, particularly along the lines of using raw materials from the refining industry.

The lecturer answered many questions from the audience who showed great appreciation for his talk, and the meeting closed with a vote of thanks to the lecturer from H. Jagger.

Howard F. Griffiths, M.B.E., Deputy Fire Chief for the County of Hampshire was the speaker on 30 April at a meeting organized at short notice as an addition to the 1951-52 calendar.

Mr Griffiths had prepared an impressive display of exhibits for purposes of illustration. The title of his talk was "Fire fighting in the petroleum industry", and he had on view a map showing the location of fire-fighting equipment throughout Hampshire, equipment used to mark the control point of a fire, and outside the club he had on show a new tank and pumping unit which was shortly to come into use at one of the Hampshire fire stations.

He opened his talk by describing the organization of the Fire Service in Hampshire and then stressed the necessity of close co-operation between the fire service and industry with their various problems relative to fire fighting. He went on to talk about the problems peculiar to the petroleum industry, which are generally associated with tank fires. The fire-fighting organization called in to extinguish tank fires are faced not only with extinguishing the fire itself, but also with the prevention of its spreading to neighbouring tanks, and it is often a problem for the officer in control, having in mind the manpower and equipment available to him, as to whether he should concentrate on isolating neighbouring tanks or extinguishing the fire in the tank. Isolating

of neighbouring tanks implies the use of very large quantities of water, which is jetted on the roof to keep the tank cool enough to prevent ignition.

Mr Griffiths then described the sequence of events when a tank ignites. Frequently the fire starts with the roof blowing off and the surface of the oil igniting. As the fire progresses the oil surface drops at a varying rate dependent on the type of oil, and a heat wave passes down the tank. The oil under the heat wave is normally close at atmospheric temperatures, but the heat wave may be as high as 580°C. When the heat wave reaches the bottom of the tank, which may happen after a period of one or two days' burning, a boilover takes place as a result of the heat coming in contact with the water on bottom of the tank. This boilover results in the explosive ejection of the tank contents and is a very serious occurrence; the radiation of heat is tremendous and Mr Griffiths mentioned the case of trees being withered at a distance of half a mile on one occasion. He then described a phenomenon of very much less severity, namely a slop-over, which can take place as a result of water in the body of oil itself and which can be precipitated by bottom foam injection.

Special reference was made to the magnitude of the task facing the fire service once a major situation develops. One recent fire was quoted as having involved 500 men, 170 vehicles and the use of 50,000 gallons of foam compound. Stress was laid on the value of walkie-talkie wireless to enable the officer in charge of the fire to maintain control of what is inevitably a complex, and sometimes a protracted, operation.

A short film was shown which depicted an experiment which had been carried out in use of bottom foam injection, and after a very short period of application the tank slopped over in a very spectacular manner.

Mr Griffiths then went on to describe the experiences at the Avonmouth fire which he illustrated with slides and a short newsreel film.

A number of questions from the audience were then answered by the speaker and the meeting closed with a vote of thanks from Dr A. W. Pearce, who expressed great appreciation for the very interesting lecture Mr Griffiths had delivered.

London Branch

At their meeting on 21 May the London Branch debated the motion that "Petroleum has done more harm than good". For the period of the debate the chair was taken by Archibald Crawford, Q.C., who was introduced by N. E. F. Hitchcock acting on behalf of the Branch chairman, Alan Deller, absent on flying training with the R.A.F. reserve.

The case for the motion was presented by G. H. Thornley, who, with philosophical eloquence, based his remarks on the peaceful pursuits and ways of humanity prior to the advent of the internal combustion engine. In a quiet and unassuming manner, Mr Thornley put forward point after point, sometimes with a humorous note and sometimes with an air of serious intent.

For the defence, R. F. Leach based his case on practical considerations, indicating the benefits which he considered petroleum had brought to enrich the life of mankind and to lessen the effort required of man to maintain himself. In the course of his speech he quoted much statistical evidence in support of his arguments.

The seconders were F. F. Musgrave for the motion and F. W. Ellis against, and both followed the same style of argument put forward by the proposers, Dr Musgrave pursuing a humorous and philosophic vein and Mr. Ellis quoting examples of the benefits to be derived from the use of petroleum products in agriculture.

After the proposers and seconders had concluded their addresses, the

matter was thrown open to general debate and the chairman had no difficulty in obtaining speakers. In fact, he had to ration strictly each speaker and even this method did not allow speeches from all those who desired to speak.

Put to the vote, the motion was carried by 49 to 10, and the meeting closed with a vote of thanks to Mr Crawford for acting as chairman.

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LONDON BRANCH SECRETARY

New secretary of the London Branch of the Institute is R. F. Leach, M.A., A.F.Inst.Pet., his address being c o Shell-Mex & B.P. Ltd., Shell-Mex House, Strand, London, W.C.2, and telephone number TEMple Bar 1234.

HELIUM PRODUCTION

In January the U.S. Government helium plants produced their billionth cubic foot of helium, and it is estimated that, to reach this figure, over 100 billion (1,000,000,000) cubic feet of natural gas has been processed.

The first full-scale plant began production at Fort Worth, Texas, in 1921. Three plants are now in operation by the Bureau of Mines. Two are in the Texas Panhandle—one near Amarillo came into production in 1929, and the other at Exell in 1943. The latter has produced about one-half of world output. The third producing plant is at Otis, Kansas, and a standby plant is located at Shiprock, New Mexico.

Before the war production had been on a laboratory scale and cost about $2,500 per cubic foot. Today's cost is 1½ cents per cubic foot.

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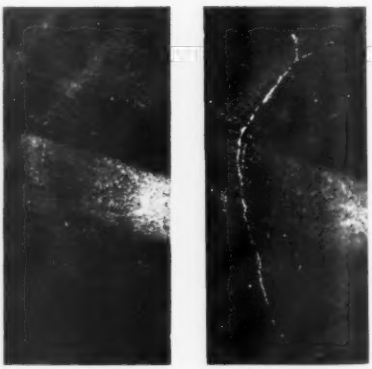
CRACK AND FLAW DETECTION

An interesting demonstration of the use of GLO-MOR fluorescent ink for the rapid and easy detection without destruction of cracks, porosity, and similar faults in metal and plastic parts was recently given by Manchester Oil Refinery Ltd. and Hanovia Ltd. in Manchester.

As the result of considerable research MOR have developed a fluorescent ink into which the material under examination is dipped or which is poured over the surface of the material. After drying the material is examined under an ultraviolet light source and surface cracks become immediately visible in brilliant fluorescence, even when viewed against a background of fluorescent material on the surface. By a quick dip in carbon tetrachloride the background can be removed, leaving a well-defined pattern of any surface cracks.

The fluorescent ink in equally applicable to magnetizable as well as non-magnetizable materials, but for rapid non-destruction examination of iron and steel parts various grades of Supramor Electro Magnetic Flaw Detection Ink are available.



A magnesium alloy casting with cracks (left) invisible to the naked eye and (right) rendered easily visible by the use of fluorescent ink.

THE EUROPEAN ASSOCIATION OF EXPLORATION GEOPHYSICISTS

The European Association of Exploration Geophysicists held its second meeting on 22 and 23 May in London.

The meeting was attended by 87 members and visitors, half of whom came from overseas. Dr Alexander Wolf, of Houston, Texas, attended as the official delegate of the Society of Exploration Geophysicists, and G. H. Westby, president of Seismograph Service Corporation, Tulsa, U.S.A., was a special guest. During the meeting telegrams of goodwill were exchanged between the Association and the S.E.G. in America.

Nine technical papers were presented and the discussions which followed the papers were at times quite animated, and at least one member found it necessary, in his excitement, to speak in three languages to put over his point!

On both days a special lunch was organized, and at the end of the meeting members, visitors and wives were entertained at a cocktail party at Grosvenor House by the directors of Seismograph Service Ltd.

It is worth recording that one of the American guests remarked, after the meeting, that he was particularly impressed by the high quality of the papers and by the wonderful friendliness and spirit of co-operation between the members of different nationalities.

The next meeting, probably in November, will be held in Hanover, Germany.

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NEW LUBOIL PLANT AT CARDON

An £8,000,000 luboil plant, with an output of 100,000 tons/year, has been completed at Shell's Cardon refinery, Venezuela. This plant comprises propane de-asphalting, furfural extraction, M.E.K/benzole dewaxing and clay contacting units. Intake will consist of Venezuelan reduced crudes.

STANDARDIZED OIL CANS

Organization of a project on the standardization of the diameter and height of motor oil cans has just been approved by the American Standards Association.

Requested by the Joint Container Committee of the American Petroleum Institute and the National Lubricating Grease Institute, the project grew out of the desire of oil companies to have interchangeable dimensions to facilitate handling the cans by filling and closing machinery.

A set of proposed American Standard dimensions for 1-quart, 5-quart, and 1-gallon cans is being prepared by a special committee appointed as the result of a general conference held to discuss the original request to ASA by API and NLGI.

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NEW ESSO TANKER

A 12,300 ton d.w.t. tanker has been ordered from Hall, Russell & Co., of Aberdeen, by Esso Petroleum Co.

Of all-welded construction, the tanker is designed for the carriage in bulk of bitumen having maximum carrying and pumping temperatures in the region of 280°F. In general appearance it follows the usual three-island tanker. Dimensions are: length (overall) 297 ft; breadth (moulded) 42 ft; draft 16 ft; displacement (approx) 4000 tons; cargo capacity 2000 tons; trial speed 11.5 knots.

Main machinery will consist of a triple expansion reciprocating steam engine of about 1300 I.H.P.

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Shell Racing Guides.—Two booklets available to motor and motor-cycle racing fans from divisional offices of Shell-Mex & B.P. Ltd., are *European Motor Racing* 1952 and *European Motor Cycle Racing* 1952. Details are given of each race and track and there is space for entry of results.

10 STEPS TO POWER

This well written pamphlet* tells the layman in easily assimilated form many of the things he ought to know about Great Britain's fuel problem.

Much of the author's general thesis will be familiar to those who have followed current discussion of the fuel situation in the Press. The criticisms that have been levelled at the various fuel industries and at the Government for its alleged lack of a co-ordinated national fuel policy are brought together. The basic theme is that, in face of rapidly increasing energy requirements, the current utilization of British coal is both illogical and wasteful. The possible economies are reviewed and the author puts forward his basis for a co-ordinated national fuel policy. He seems however, rather to over-emphasize the results that may be hoped for from the economies in fuel consumption; for example, the saving to be expected from the restriction of the use of electricity for space heating is likely to be of minor importance. Moreover it is, surely, because its wide daily and seasonal fluctuation causes a lowering of the average load factor of the British power stations that this use of electricity ought to be discouraged rather than because of the low thermal efficiency at which coal is converted to electricity at the average power station.

Oil industry readers will be interested by the striking facts cited on pages 34 and 35 regarding the valuable service rendered by "stand by" diesel generating sets which have obviated power cuts in many factories since 1947.

The pamphlet is designed not only to inform public opinion on one of the central problems of Britain's national economy but also to advocate specific remedial policies. It is here that the reader, whether expert or layman, is likely to have doubts, or at any rate to suspend judgment regarding the necessity of some of the remedies proposed, until the conclusions of the Ridley Committee become available to the public.

Some of the measures proposed by Mr Nabarro seem indeed to be more acceptable if put forward to help in overcoming a temporary situation than as permanent features of the nation's economy. If it should prove that the post-war reconstruction and restocking boom is now coming to an end (and in the field of energy consumption, the amelioration of the coal situation in Western Europe suggests this possibility) then it might well be that, in formulating a national fuel policy for the United Kingdom, more attention could be paid to the preferences of the consumer than is permissible according to the strict dictates of perfectionism in the utilization of indigenous natural resources.

T.C.O.

*"10 Steps to Power". Gerald Nabarro, M.P. London: St. Catherine Press, Ltd., 1952. pp.72. 3s. 0d.

★ ★ ★

NEW SHELL FILMS

Two films recently released by Shell-Mex & B.P. Ltd and made by the Shell Film Unit are *An Introduction to the Heat Engine* and *Machining of Metals*. The former, which runs for 23 minutes, is an elementary treatment of the use of fuels in engines, the presentation being simplified by visual analogies.

Machining of Metals surveys the principles of machining and demonstrates the action of cutting, the types and design of tools, the action of cutting fluids, and the advances in measurement and testing. It is admirably suited for technical audiences. Showing time is 27 minutes.

Both films are 16-mm sound, have the advantage that there is no background music to distract attention, and may be borrowed free of charge from the Company or from Petroleum Films Bureau, 29 New Bond Street, London, W.1.

PETROLEUM AT THE B.I.F.

Petroleum at the 1952 BIF was mainly represented by exhibits of lubricants and special products, the emphasis as usual being on utilization in industry. There was a good proportion of IP Member-Companies at the various sections, including the following. A brief note of the class of exhibit is given.

At Birmingham

Alexander Duckham & Co. Ltd. Lubricants and cutting fluids. Anti-dermatitis skin cleansers and barrier creams.

English Electric Co. Ltd. A typical layout for a diesel power-house.

Esso Petroleum Co. Ltd. Utilization of petroleum products and a demonstration of manufacturing processes.

J. H. Fenner & Co. Ltd. Power transmission belting.

Fletcher Miller Ltd. Special lubricants and cutting fluids.

The Fullers Earth Union Ltd. Activated fullers' earth filtering mediums, and weighting materials for rotary drilling fluids.

G. A. Harvey & Co. (London) Ltd. Steel equipment and sheet metal work, including the ellipsoid spun head exhibited at the Festival of Britain in 1951.

W. T. Henley's Telegraph Works Co. Ltd. Electrical systems, cables, equipment, etc.

I.C.I. Ltd. Metals Division demonstrating the use of metals and alloys in engineering and transport.

Johnson & Phillips Ltd. Electrical appliances and cables.

Manchester Oil Refinery Ltd. Industrial oils and lubricants and cutting oils.

Metropolitan-Vickers Electrical Co. Ltd. Demonstrations of manufacture of motor windings and of automatic electronic control.

Rubery Owen & Co. Ltd. Sheet metal work, handling equipment, gas cylinders, etc.

Shell-Mex B.P. Ltd. Fuel oils and lubricants.

Stothert & Pitt Ltd. Concrete, asphalt and tarmacadam mixers.

John Thompson, Ltd. Steam generating plant and chemical plant.

Vacuum Oil Co. Ltd. Industrial lubricants and cutting oils.

The Victaulic Co. Ltd. Pipe jointing and couplings.

The Yorkshire Copper Works Ltd. Solid drawn tubes for oil equipment and other purposes.

At Olympia, London

H. J. Elliott Ltd. Petroleum testing apparatus to IP and ASTM specifications.

The Fullers Earth Union Ltd. Fullers earth for oil refining and regeneration and for well drilling.

W. & J. George & Becker Ltd. Testing apparatus, chemicals, and reagents.

G. A. Harvey & Co. (London) Ltd. Steel office and storage furniture.

I.C.I. Ltd. Technical services to users of chemical products. Various moulding powders shown by Plastics Division at Earls Court.

Monsanto Chemicals Ltd. Detergents and lubricating oil additives and various chemicals for industry.

Petrochemicals Ltd. Chemicals from petroleum.

Shell Chemical Manufacturing Co. Ltd. Chemicals from petroleum.

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PAKISTAN DEVELOPMENT

Summarizing the development of the oil industry in Pakistan, M. J. Condon, chairman of the board of directors, Pakistan Petroleum Ltd, said recently in Karachi that the only established producing region of Pakistan is in the Potwar Basin lying west to south-west of Pindi. There four fields have been established—Khaur, Dhulian, Balkassar and Joya Mair, with a total production of approximately 3,500 barrels of oil per day. The crude varies considerably. In the cases of Khaur and Dhulian it is of good green quality with a large proportion of light fractions, whereas at Balkassar and Joya Mair it is bituminous. The only new major find has been at Dhulian where some deep oil of the capacity of about 400 barrels per day of good quality crude has been found.

Regarding exploration, six major tests were in operation at the end of April at Bains and Chak Naraung in the Punjab, at Sui in Baluchistan, and at Patharia and Sylhet in East Bengal, while work at Patiya near Chittagong was about to start. An aerial magnetic survey has been carried out in East Bengal as the first step in surveying all the area covering the Brahmaputra Delta.

I.B.P. EXHIBITION

Members of the Shell Photographic Unit were represented at the recent annual exhibition of the Institute of British Photographers, those exhibiting being John Bryson, Norman C. Bunch, Charles Hynds, Derrick Knight, M.B.E., and W. F. Simmonds. The combined total of 29 photographs included an excellent series of eleven studies by Derrick Knight illustrating the East Indies and its peoples. The remainder of the Shell pictures included some fine shots of petroleum plant and of machines.

Petroleum plant also featured in exhibits by R. H. Jones, J. H. Hall, Percy Butler, and Charles Wormald.

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OIL FOR BRITAIN EXHIBITION

An interesting exhibition arranged by Esso Petroleum Co. Ltd. is now touring the provinces. Centred around the model of Fawley Refinery are flow charts, models, photographs, samples, etc., and there is a cinematograph exhibition attached. The object of the exhibition, as E. R. Latham said at a luncheon while the exhibition was in Ipswich, is to stimulate interest in the oil industry and to show what oil is, how it is processed, what sort of people are in the industry, and what jobs they do.

That the exhibition is succeeding in its educational objects is evident from the number of school parties which are reported to have visited it in the towns where it has been shown.

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CELANESE EXHIBITION

Concurrently with the B.I.F., an exhibition of applications of cellulose acetate in industry was staged at Celanese House, Hanover Square, London, W.1. Of particular interest were such safety devices as light weight face shields and welder's eye shields made from tinted shatterproof transparent sheeting, and inspection windows and machine guards of wire-mesh reinforced sheeting.

APPOINTMENTS VACANT

ESSO Petroleum Company Limited, Refinery Department, Fawley, Hants, have the following vacancies on their graduate staff:

(A) **Chemical Engineers.** There are several vacancies with good prospects in the Technical Department for Chemical Engineers and Chemists. Candidates should have good honours degrees, and experience in the Petroleum or allied industries would be an advantage.

There are also a few Senior Chemical Engineering appointments vacant, carrying four-figure salaries. Duties will cover the work of the various sections of the Technical Department, including planning of refinery operations and process engineering. Candidates should have a good degree in Chemical Engineering and some years experience in the petroleum refining industry in a responsible technical capacity.

(B) **Mechanical Engineers.**

1 Area engineer for work of a practical nature involving the organization and planning of all maintenance and construction work in a section of the Refinery.

3 Inspection Engineers for the inspection and testing of furnaces, towers, pressure valves, heat exchangers, piping, valves, fittings, machinery, etc., from the point of view of corrosion, erosion, fatigue, etc. Duties include interpreting and applying recognized engineering codes and practices; determination of permissible operating conditions; investigating unusual conditions, in particular the overcoming of corrosion problems; following up new developments and methods, testing materials and checking specifications; maintaining records, special reports, etc. Familiarity with pressure vessel design and construction, knowledge of U.K. and U.S.A. standards, and some experience of corrosion, stress and other metallurgical problems would be desirable. Previous experience of refinery or chemical plant an asset. Candidates should have no fear of heights or enclosed spaces.

For both these engineering vacancies only those candidates will be considered who have at least a Pass Degree in Engineering; preference will be given to those who have served an apprenticeship or who have had several years practical workshop experience. Relevant experience in the Petroleum or Chemical Industries would be an asset but is not essential.

These are all regular posts with salaries appropriate to age, qualifications and experience, an excellent and comprehensive pension scheme and other benefits, and very

good social and recreational facilities. The Refinery is situated on the edge of the New Forest, bordering Southampton Water and the Solent.

Applications should be sent in writing to the Employee Relations Superintendent at the above address, giving details of age, qualifications, experience, availability, present salary and salary required. These details will, of course, be treated in strict confidence.

Three or Four Contract Engineers required immediately by **Kellogg International Corporation, London.** Should preferably have had University training, working knowledge of mechanical engineering science, some knowledge of metals and have spent eight or ten years or more in industry. These are new posts and are required for expansion programme for petroleum refinery and chemical plant design and construction, but applicants considered with good coke oven, gas works, sugar refinery, distilleries, practice. Duties would consist of producing from finished process data and flow sheets, etc., specification of equipment such as large fractionating columns, heat exchangers, piping, pumps, instrumentation, etc. Good salaries and future with executive status to really suitable high calibre men with requisite ability and experience. Applications stating details of age, education, experience, in strict confidence to C.W.K., Box 1068, *IP Review.*

A keen, qualified **Engineer,** with drive and initiative and some chemical knowledge, aged 30-45, experienced in general use of liquefied petroleum gases in the iron and steel and other industries, required by an expanding group of Companies with Head Office in London. Main responsibilities will concern technical application and utilization problems. Salary according to qualifications; post offered has great prospects and applicant would be required to progress with the business which is expanding rapidly. Apply in writing giving full particulars. Box 1069, *IP Review.*

The Midland Tar Distillers Ltd require a **Chief Chemical Engineer,** the post being vacant owing to the death of Mr Roland Scott. Only applicants of outstanding ability and wide experience will be considered. Assistance will be given in obtaining suitable living accommodation. The salary will be £1500 per annum or over according to the ability and qualifications of the candidate. A compulsory pension scheme is in operation. All replies should be addressed to The Personnel Manager, The Midland Tar Distillers Ltd, Oldbury.

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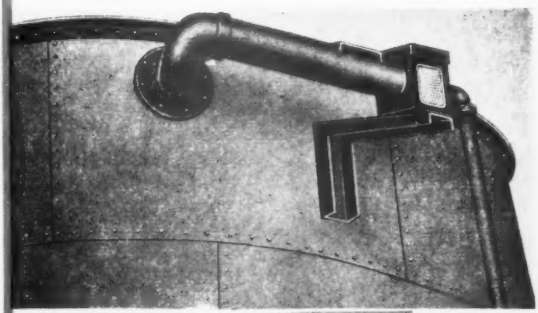
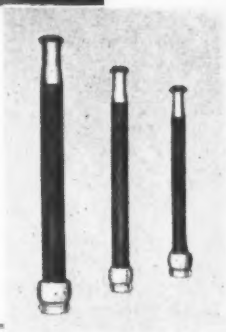
The mobile unit carries pump, around-the-pump proportioner, airfoam liquid tank, foam makers, airfoam nozzles, etc. Nozzles are made in 3 light weight models producing 250, 500 or 1,000 galls. of foam per minute respectively, at inlet water pressure of 100 lbs. p.s.i.





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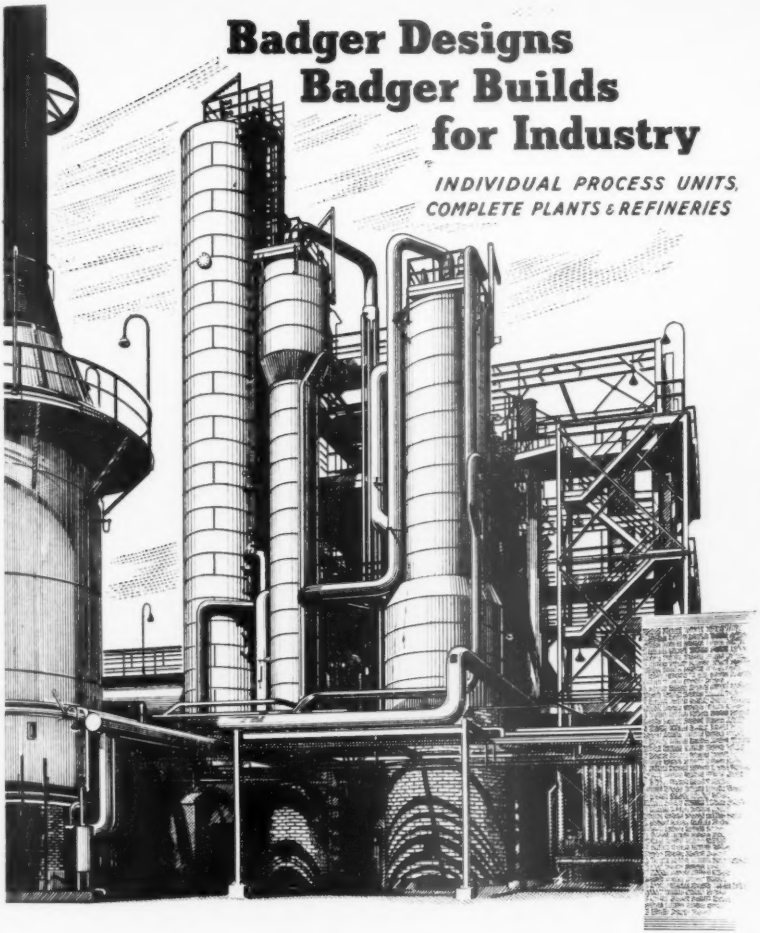

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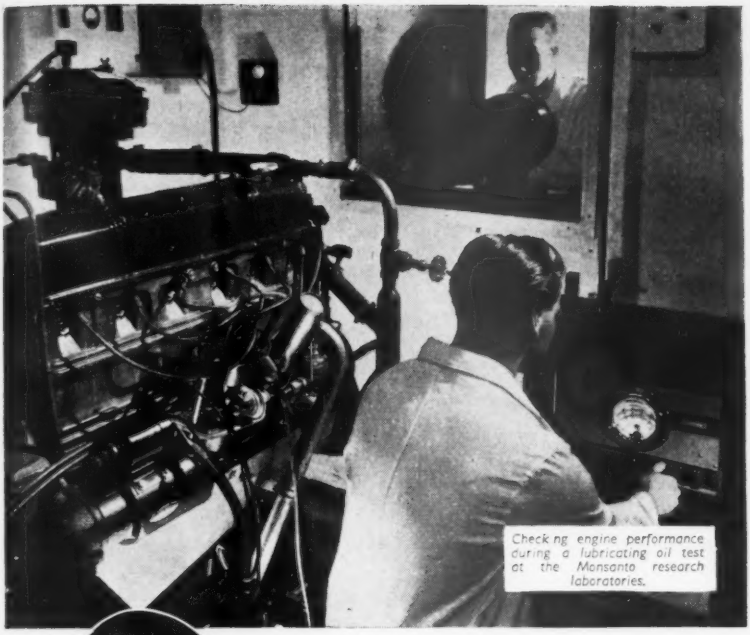
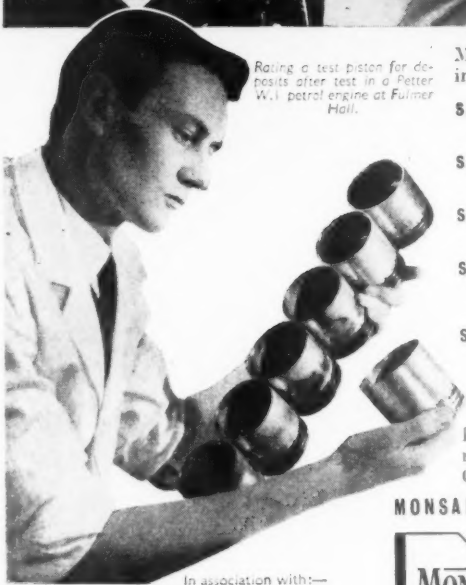


Checking engine performance during a lubricating oil test at the Monsanto research laboratories.



Rating a test piston for deposits after test in a Petter W.1 petrol engine at Fulmer Hall.

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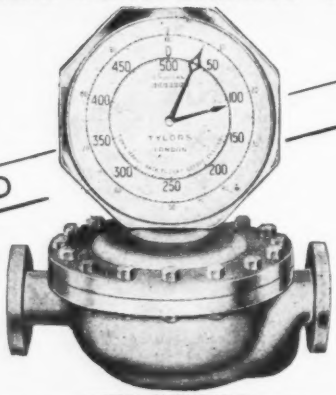

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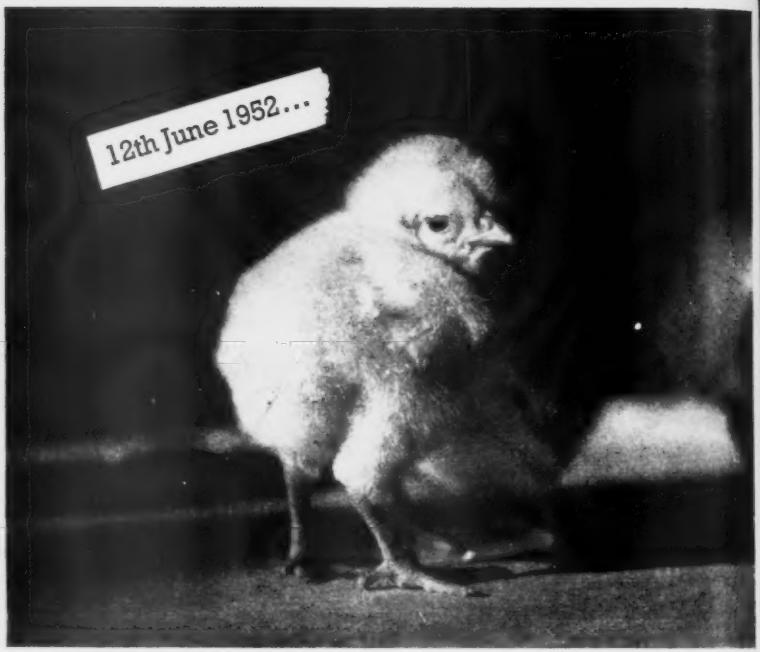

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